SECTION 1. DATABASE AND DOCUMENTATION OVERVIEW

Support Document #72

Abstract

Federal agencies such as the U.S. Environmental Protection Agency (U.S. EPA), along with other state and local agencies, have a need to improve and enhance the process by which ecological and human health hazard assessments are performed. This has resulted in a range of activity from modeling hazard evaluation of new and existing chemicals and pesticides as well as evaluation of impact assessments associated with effluent, leachate, and environmental monitoring data. Research programs within the U.S. EPA are expanding to further support the scientific basis of ecological and human health risk assessments for chemical pollutants.

ECOTOX provides a single user interface for identifying and retrieving toxicity data for aquatic life, terrestrial plants, and wildlife. Data are obtained primarily from the peer reviewed literature and various quality assured data files such as the U.S. EPA, Office of Pesticide Programs, Ecological Effects Branch's Ecological Effects database of toxicity data for aquatic and terrestrial species. Currently, ECOTOX includes over 228,000 toxic effect records from approximately 13,000 references for more than 7,300 chemicals and 4,100 aquatic and terrestrial species. The current version of ECOTOX is a UNIX-based system that can be accessed by governmental entities and their cooperators and contractors through the Internet or a telephone call using a modem and communications software. Data tapes are also available through the National Technical Information Service in Springfield, VA.

For further information and inquiries regarding access to the ECOTOX database, contact:

Scientific Outreach Program
U.S. Environmental Protection Agency
Mid-Continent Ecology Division
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Duluth, MN 55804

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MED DATABASE OVERVIEW

Introduction

In the development and implementation of ecosystem management decisions there is the need to establish scientifically credible risk assessments for chemical stressors. Ecological assessments are required to characterize and diagnose the risk of chemical pollutants and to predict future risk as a function of environmental management options.

Within the U.S. EPA, Office of Research and Development's (ORD) strategic plan, one long-term goal is to facilitate the exchange of credible scientific data and risk assessment information among private and public stakeholders. To meet this objective, the U.S. EPA, National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division in Duluth, MN (MED-Duluth), has been developing a suite of databases and expert systems that can be used by risk assessors and researchers to quickly located relevant ecotoxicology data and models. MED-Duluth recently released Version 1.0 of ECOTOX, a system that links ecological effect databases.

Development of the ECOTOX database ensures that high quality, properly reviewed, toxic effects data are readily available to the regulatory and research community for use in performing ecological risk assessments and evaluating results of environmental programs. The ECOTOX database provides a comprehensive and readily accessible repository of critical information on single chemical exposures to aquatic and terrestrial species.

ECOTOX integrates three existing U.S. EPA databases, AQUIRE, PHYTOTOX, and TERRETOX, which include unique toxicity data, derived predominately from the peer-reviewed primary literature, for aquatic organisms, terrestrial plants and wildlife species, respectively. The AQUIRE (**AQU**ire **I**nformation **RE**trieval) database, was developed at MED-Duluth in 1981, and serves as a repository for aquatic toxic effects data from the national and international literature. PHYTOTOX and TERRETOX were developed at the NHEERL, Western Ecology Division in Corvallis, OR (WED-Corvallis), but are currently maintained at MED-Duluth. PHYTOTOX and TERRETOX include data on terrestrial species. All three databases include lethal, sublethal, and residue effects data, with the exception of PHYTOTOX which does not include residue data. For each database, relevant publications are identified through searching online database sources and commercial databases on CD-ROM. Manual searching includes examination of journals and table of content and searches of relevant bibliographies. searches and by examining review article bibliographies.

AQUIRE Database

Aquatic toxicity literature has been reviewed and entered into the system for fifteen years, the majority of which encompasses test results reported from 1970 to the present. Current publications are continually and systematically acquired and reviewed. Computerized laboratory data files from the public sector and available unpublished reports are also acquired and critiqued.

Data obtained from independently compiled data files must meet the AQUIRE data parameter and quality assurance guidelines. Data files that have been included in AQUIRE are the U.S. EPA MED fathead minnow acute toxicity database (Center for Lake Superior Studies; University of Wisconsin-Superior, 1984, 1985, 1986, 1988, and 1990), datasets from France, Germany, the Netherlands and Russia and the Office of Pesticide Program (OPP) Ecological efforts database. Access to the world's aquatic toxicological data is enhanced through international exchanges with the Organization for Economic Cooperation and Development (OECD) and with the Borok Institute in Russia to promote a centralized source for toxic effects data.

The literature included in AQUIRE must report effects on aquatic organisms, tested in vivo and the data derived from the tests must be unique (i.e., not published in reviews or summaries). Only single chemical exposures, with defined concentrations and from which an effect is derived, are encoded in AQUIRE. Effect records which do not report an exposure duration are not coded for the AQUIRE database unless the data were reported in an abstract. Section 2 discusses the literature search and acquisition procedures utilized for the AQUIRE project.

The data elements included in AQUIRE reflect standard parameters within a toxicity test. The data encoded are evaluated according to existing standard test methods such as those from the American Society for Testing and Materials (1993), Code of Federal Regulations (1992), and the American Public Health Association et al. (1992). Each test reviewed for AQUIRE is assigned a documentation code that indicates the amount of methods and results documentation available in the scientific paper. Section 4 describes the data encoding process. Data are entered and updated regularly according to standard procedures described in Section 5.

AQUIRE is catalogued by the toxicant tested using the Chemical Abstracts Service (CAS) registry number. If a CAS registry number is not available through standard sources the toxicity data cannot be included in AQUIRE. Additional toxicants not included in AQUIRE are water chemistry effects (e.g., pH), complex effluents, and chemical mixtures. Chemical mixtures may be interpreted broadly, however for AQUIRE ... if a pesticide is a mixture of two active ingredients, each of which may have a separate CAS number, if the formulation has a CAS number the chemical reported is the formulation. If the exposure is based on two metal compounds but

the effect is based on one ion, eg copper sulfate and copper chloride but Cu is the toxicant, its okay. Code copper as the test chemical with the two compounds in chemical characteristics. (Anne put this in terretox and in the coding guidelines sections also)

If a publication contains data for a single chemical besides one of the above categories of toxicants, the paper is retained and only the single chemical data is used in AQUIRE, Section 6 discusses the chemical verification procedures.

Test organisms are limited to those that are exclusively aquatic. Amphibian data for purely aquatic lifestages of the organism are included. Classes of organisms associated with the aquatic environment (e.g., birds, mammals, reptiles) and the microscopic communities (bacteria and virus) are omitted. The test organisms are categorized according to current taxonomy and stored in AQUIRE such that toxicity information can be retrieved at many taxonomic levels (e.g., class, order, family, genus, and species). Section 7 discusses the species verification procedures.

Information storage in AQUIRE is organized by individual aquatic toxicity tests or bioassays. Each toxicity test record contains information about the test chemical, species, effect endpoint, exposure concentrations, and conditions under which toxicity test was conducted. AQUIRE is updated regularly, and ongoing maintenance and development are projected to incorporate new publications. Resulting from this effort is a system that presently contains data on more than 2,900 species, 5,900 chemicals, 10,000 references, and approximately 60 effects from 145,000 toxicity tests. AQUIRE is a summary of available aquatic toxic effects' data and is subsequently designed to be used as a reference tool. Researchers or managers using AQUIRE for analyses or summary projects should consult the original scientific paper to ensure an understanding of the context of the data retrieved from AQUIRE. Appendix B of Section 8 (Technical Support) provides a current listing for sources of the AQUIRE database.

PHYTOTOX Database

PHYTOTOX is a terrestrial plant toxicity database established to provide efficient access to a large body of published literature regarding the influence of single applications of organic anthropogenic chemicals on terrestrial vascular plants. PHYTOTOX allows comparison of experimental results from a broad spectrum of research activities.

Retrieval, review, and encoding of plant toxicology literature into PHYTOTOX started in 1981. PHYTOTOX contains publications dating from 1926 to 1991, and is continually updated and maintained with new, applicable information. Currently, PHYTOTOX refers to over 3,900 publications, 2,000 chemicals, and 1,300 species. Publications are acquired through literature searches, and are screened for

applicability to the PHYTOTOX database. Eligible plant toxicity papers are retrieved, reviewed, and coded following the specific guidelines outlined in this document.

The PHYTOTOX database contains scientific information derived from individual terrestrial plant toxicity studies. Each toxicological effect record contains specific information about the test chemical, the plant species involved, experimental information, and symptom or effects data.

TERRETOX Database

TERRETOX is a terrestrial wildlife toxicity database established to provide data linking quantified chemical exposures with observed toxic effects. TERRETOX quantifies relationships between anthropogenic chemical concentrations in environmental media as well as identifies sources of alternative data on laboratory species when there is a paucity of information on wildlife species. The focus for TERRETOX is to collect publications with data for wildlife, ie. mallard, pheasant or bobwhite avian species and meadow vole, deer mouse or mink mammalian species; and beneficial invertebrate species, honey bee, *Megachile rotundata,* or *Nomia melanderi,* recommended for testing by the current standard methods (see USEPA and ASTM series). If data for other species, including laboratory, domestic or non-beneficial organisms, is reported in the paper, data for all test species is coded for entry into TERRETOX. Bacterial tests are not included within any database within ECOTOX at this time. Publications focusing primarily on laboratory, domestic or non-beneficial organisms are not actively identified or coded at this time.

Wildlife toxicology literature has been retrieved, reviewed, and entered into TERRETOX since 1983; the majority of which encompasses test results reported from 1970 to the present. TERRETOX is continually updated and maintained with new, applicable information. Currently, TERRETOX contains 5,000 publications, 2,025 chemicals, and 330 species. Publications are acquired through literature searches, and are screened for applicability to the TERRETOX database. Eligible wildlife toxicity papers are then reviewed, and coded following the specific guidelines outlined in this document.

The TERRETOX Wildlife Toxicity database contains scientific information derived from individual terrestrial wildlife toxicity studies. Each wildlife toxicological publication entered into TERRETOX is assigned a paper identification number and each record contains specific information about the test chemical, the species involved, specific and general exposure details, effect/endpoint data, calculated effects data, and residue data.

Access to ECOTOX

Overview

The ECOTOX software provides a single user interface where data can be retrieved from one, two or all three databases. Each test record contains information about the chemical, organism, exposure condition and observed effect under which the toxicity test was conducted. The ECOTOX software provides flexibility when searching and retrieving data within these fields. There is a default output format, which varies depending on the database, that provides sufficient information to give the user an understanding of the data record. Users can also modify the output and include additional information which may be important when assessing the usefulness of the data. The resultant output can be sent through the Internet to any valid E-mail address or can be downloaded, to an ASCII file using communications software.

The ECOTOX database is located on the UNIX at the EPA National Computer Center. The database can be accessed using an EPA network or Internet via the UNIX system or through a modem and personal computer. A user-friendly, menu-driven program to extract toxicity information has been developed for use by government offices. Magnetic tapes of the data may be purchased from the National Technical Information Service (NTIS). Two versions are available:

* ECOTOX (AQUIRE, PHYTOTOX, and TERRETOX) for VMS (PB97-500318) ($265 US, Canada and Mexico, $530 all others). This version is specifically for VAX/VMS computers. It contains the data plus an executable copy of the ECOTOX search and retrieval program that is used for online government access.

* ECOTOX (AQUIRE, PHYTOTOX, and TERRETOX) for non-VMS (PB97-500292) ($265 US, Canada and Mexico, $530 all others). This version is for all other types of computers. It contains the data files but no executable programs.

Both versions may be purchased in tape densities of 1600 or 6250,as a 3480 cartridge or CDROM. Documentation is included, but may be ordered separately as PB95-227112.

There are several commercial vendors of ECOTOX for access by the private sector. See Appendix B of Section 8 (Outreach) for a current listing of ECOTOX sources.

MED DATABASES DOCUMENTATION OVERVIEW

Quality Assurance Procedures

The purpose of this section is to present the procedures for assuring the quality of data entered into the ECOTOX database. Quality assurance procedures begin with literature search and acquisition, and continue through the literature review process, the chemical and species verification, and data entry. In addition to manual checks, there are various computerized checks within the database structure. Quality

assurance procedures are also established for technical outreach support and Standard Operating Procedure updates.

ECOTOX Literature Search and Acquisition

The objective of literature search quality assurance is to ensure acquisition of all possible literature applicable to ECOTOX databases of AQUIRE, PHYTOTOX and TERRETOX. The literature acquisition component seeks to ensure that duplicate publications and/or duplicate pieces of data are not entered into the bibliographic or data files. The literature search and acquisition procedures are discussed in Section 2 of this document. Figure 1 provides an overview of the search and acquisition process. The points at which quality assurance occurs are highlighted by shading.

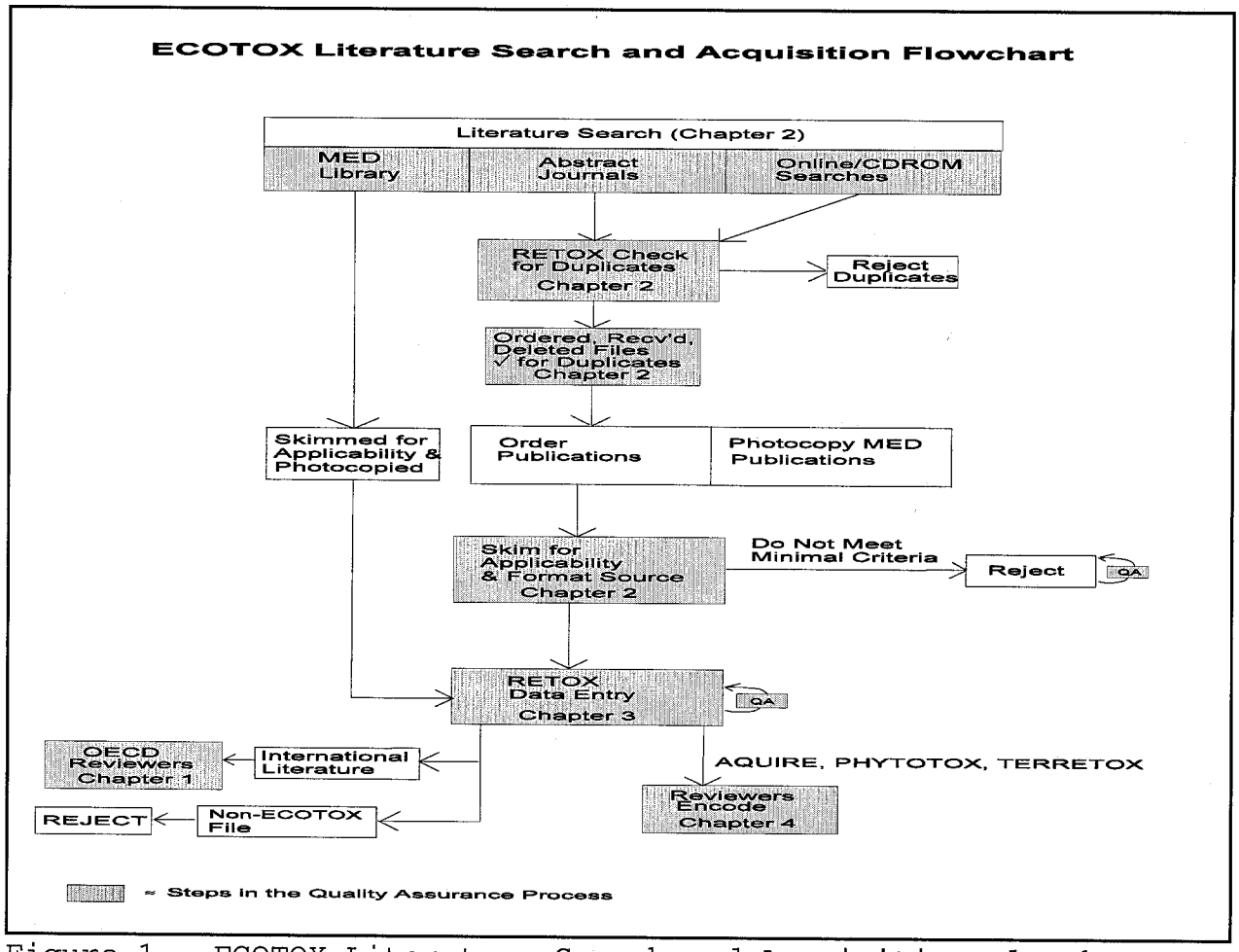

Figure 1. ECOTOX Literature Search and Acquisition Flowchart

Literature Review

Once the publication and the data it contains have been identified as suitable for inclusion in ECOTOX, the data from the publication is encoded. Accepted standard methods, such as the Standard Evaluation Procedures, ASTM, and EPA publications, for each of the study types and endpoints are used to identify the appropriate quality assurance criteria and subsequent documentation code (refer to Section ? for an expanded discussion).

Integrated into the reviewing process are the quality assurance steps outlined in Figure 2. These steps include the verification of duplicate articles and chemical or species names. Sections 4, 6, and 7 discuss the literature, chemical and species verification processes.

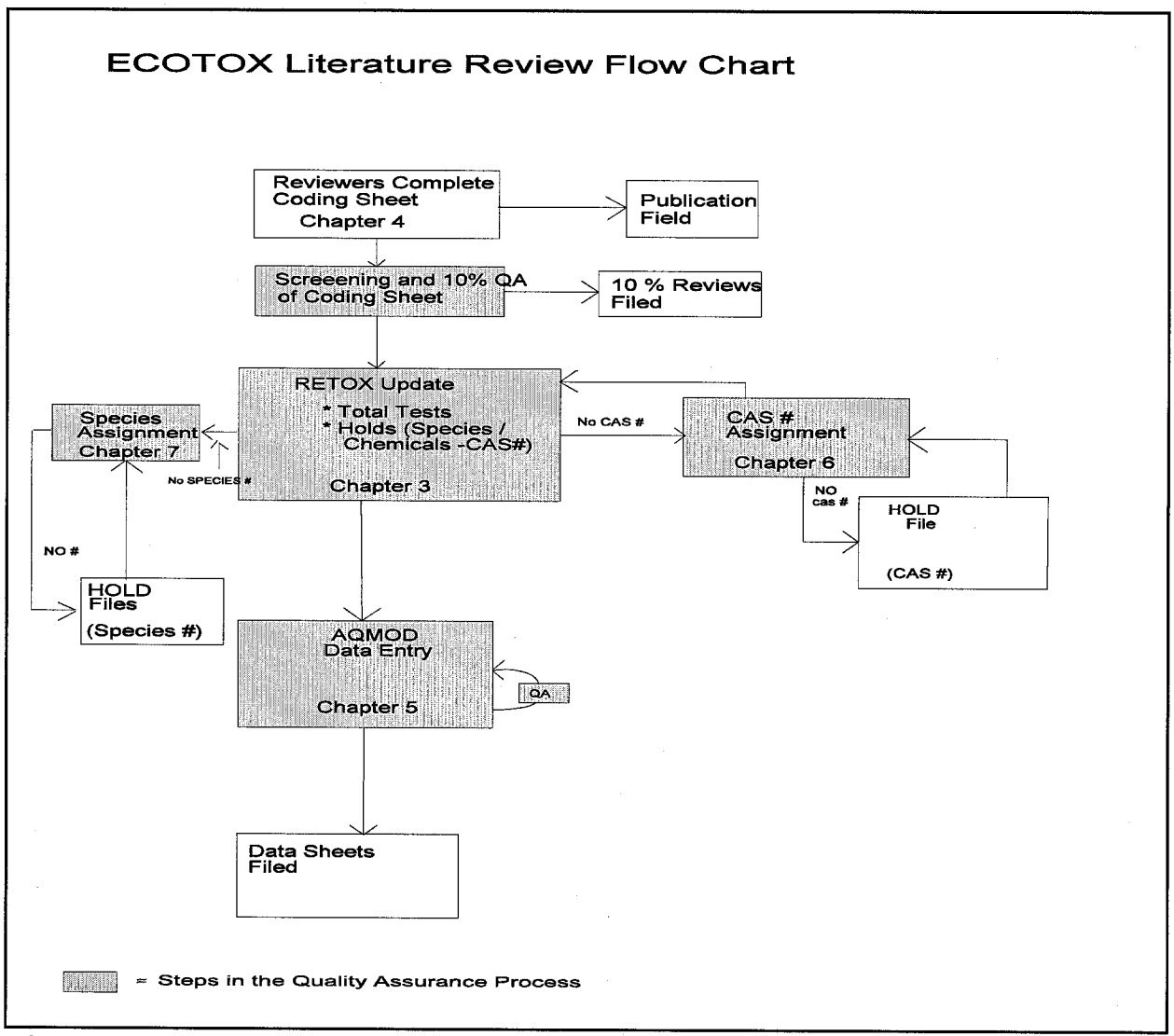

Figure 2. ECOTOX Literature Review Flow Chart

The ECOTOX database characterizes the documentation provided in each publication by the assignment of a Documentation Code ranging from Complete (most documentation) to Incomplete (no documentation). For example, tests with statistically derived endpoints or for which a bioconcentration factor (BCF) has been calculated may be assigned Documentation Codes ranging from Complete to Incomplete to Moderate depending upon the extent of methods documentation, as well as the completeness of the test techniques utilized in the study.

Following review of a publication there are two levels of quality assurance initiated. The first is a screening of all coded sheets for completeness and accuracy in coding. Second, ten percent (10%) of the articles reviewed for ECOTOX are independently reviewed by two different reviewers. The ten percent replicate review process assures data integrity and promotes routine evaluation of coding practices. Through this iterative process, strengths and weaknesses in data abstractor expertise are identified and specific programs are established to enhance expertise where needed. Refer to Section 4 for a detailed discussion of this process.

Data Entry

AQUIRE

The transfer of encoded information into completed data file format is initiated through the AQMOD software. Figure 3 documents the data entry process from the completed coding sheet to the point at which the data becomes available to the public. Points at which quality assurance occurs are shaded and references to the chapters which will provide detailed information are noted in each box. Section 5 discusses the data entry, verification and update procedures. Data entry of reference, chemical and species information is implemented through RETOX, CHEMNAME and SPECTAR files as summarized in Section 3, 6, and 7, respectively.

PHYTOTOX

No data entry at this time.

TERRETOX

Data entry documentation under development.

The originator is responsible for providing CAS numbers (see Section 6) and taxonomically verified Latin names and grouping (e.g. fish family) according to our major/minor listed in Section 7, Appendix A. Reference citations must be formatted to the bibliographic guidelines outlined in Section 3. Non-English titles and sources should be translated, and all publications used for review should be retained or easily accessible.

New data should be submitted using the AQUIRE PC Data Entry Program (PC-ADE) Version 1.1 software that defines the fields required for input into AQUIRE. Although the PC-ADE software is the preferred method to generate dBASE files which can be read and imported into AQUIRE, other software-generated files will be considered. An ASCII data file with fixed field lengths is appropriate. If an alternative format is used, a written description should include the file name, a list of the field titles, the data type for each field (character or integer), and the size of each field. Additional information must include the abbreviation definitions and define any non-English terms.

Data Entry

Data Set Quality Assurance

All data sets are tracked by logging each data set as they are received (Tables 1 and 2). The EPA coordinator coordinates all contacts, timing for quality assurance and updating the data set information.

Data sets are presented in two formats, completed coding sheets or electronic files. The steps for quality assurance are the same in any format. The quality assurance begins by ensuring that the five minimal criteria for inclusion have been met. Coding guideline adherence is reviewed by the data coordinator. The total applicable tests are determined as the references are entered into RETOX. Data sets are identified in RETOX with a Reference Type unique to the originator (see Section 3). If species and CAS numbers are missing or incomplete, they are extracted and returned to the originator for further verification. The reason for rejected tests is noted. The final verification of species and CAS numbers is performed by AQUIRE staff.

The data are updated either using AQMOD (for coding sheet submission) or electronically. Correspondence regarding the update completion and data discrepancies are forwarded to the data set originator via the EPA coordinator. Updates to the coding guidelines and database user information are also forwarded on a regular basis.

All past correspondence is archived with the EPA Database Coordinator. The submitted dataset information is archived with either the data coordinator (manual submissions) or program coordinator (for electronic submissions). Table 1 is a data

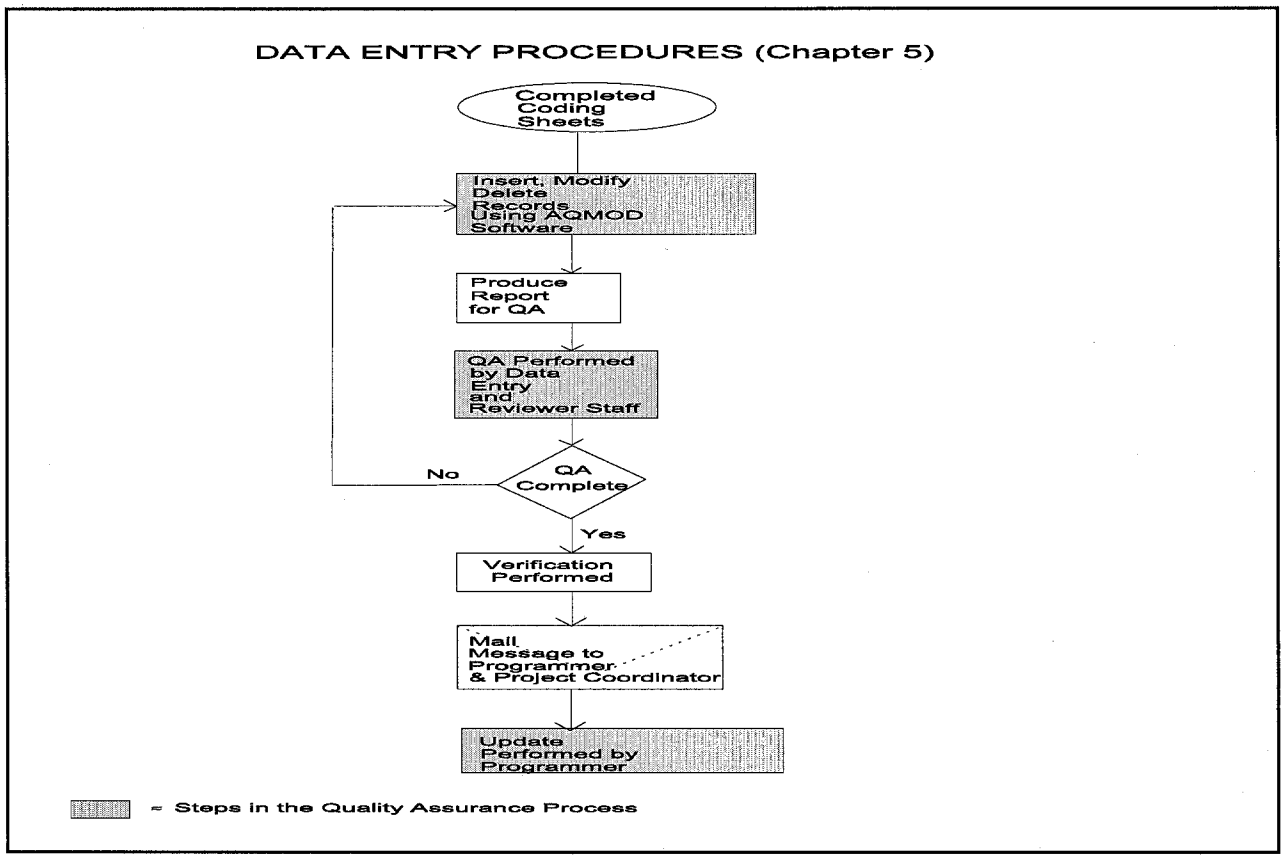

Figure 3. Data Entry Procedures Flowchart

Technical Support

Data Set Submission Requirements

The AQUIRE database will accept submission of electronic datasets such as the OECD and EPA files referenced in Sections 1 and 4. The data set originator is responsible for meeting the requirements listed in this section when submitting new data. The data must be coded to meet current coding guidelines (see Section 4). The key elements that must be included are: CAS number and chemical name, test organism, effect, exposure duration (except for abstract format) and effect concentration. If tests are missing any key element, the data are rejected. The originator is responsible for the integrity of these data. If the EPA coordinator encounters any discrepancies while incorporating the data set, the data in question will be returned for further quality assurance. The originator should retain all original coding sheets.

summary form used for each dataset submitted. Table 2 is an example of a data submission log submitted to the EPA Database Coordinator periodically.

Table 1 Netherlands Data Submission Log for 1992

Reference Number	Total Tests Submitted	Tests on Hold	Comment
5180	52		
5331	28		
5333	420		
5336	541		
5337	134		
5348	21	21	Lack verification for chemical: -2,2'3,3'-Tetrachlorodipropylether (21 tests)
5356	165		NOTE: Discovered two records were entered twice (Duplicates will be deleted
5367	18	8	Lack verification for chemicals: -HOE E 1946 (2 tests) -Lith solvent hg 95 (2 tests) -Lith solvent 804 (2 tests) -Rodine 240 (2 tests)
5370	18	4	Lack verification for chemicals: - Arichlorphon (2 tests) - Phenoprop (2 tests)
5374	65	9	Lack verification for chemicals: - Benzonaphtafuran (2 tests) - n,n'-Dimethylthioacetamide (2 tests) - Phtalane (2 tests) - n,n'-Methylpropylthiourea (2 tests) -4,6-(n)prophylthiourcil (1 test)
5375	188		
5378	20		
5390	168		
5400	39		
5411	2		
5414	16		
11039	34		
11044	102		
TOTAL:	**2031**	**42**	

Receiving Data: DATA SET:_____

Sender's Name(s): _____
Sender Inst.: _____
Sender Phone: _____
Sender Address: _____
_____
Date Received:_____
Receiver's Name: _____
Number of Data Records: _____
Number of References: _____
Data Format: _____
Data Archived (Person's Name, Place, Filename(s)):
_____
___

Quality Assurance of Data:

Total Tests Per Reference Determined: _____
References that Require Translation: _____
References that have Incomplete Citations: _____
Total Missing Species: _____ Records w/o Species:
_____
Total Missing CAS# : _____ Records w/o/
CAS#:_____
Number of Rejected Reference: _____ Why?

Number of Rejected Tests: _____ Why?

Comments About Adherence to Current Coding Guidelines:

Updating:

References Entered in RETOX: _____ Date: _____
Tests Updated in AQMOD/Electronically: _____
Date:_____

Correspondence:

Date: _____ Topics?
Sent to Whom: _____

Table 2 Data Set Tracking Form

Scientific Outreach

The technical support program provides technical assistance to database users in a timely and precise manner. The quality assurance procedures consist of tracking the types of support and verifying the accuracy of the information provided. Refer to Section 8 for a full discussion of the technical support process.

Document Update

AQUIRE electronic documents are updated periodically due to changes in terminology, technology and/or procedures. The technical writer maintains the original, unabridged version of each SOP. Staff may give the technical writer a hard copy of the documents with edits made to the revisions. The technical writer will make the edits and produce a revised hard copy. Some authors prefer to make their own edits/changes to SOP files. In this case, the technical writer will provide an electronic copy of the document to the staff member. The author will make the changes, and provide the most current electronic copy to the technical writer. When the edits are complete, the technical writer will summarize changes in the monthly report file on the computer of the technical writer. Periodically, hard copies are provided to the EPA Database Coordinator for review and approval. All modifications to the SOPs must be approval by the EPA Coordinator prior to implementation.

As a result of the updated information, the correlating documents are also updated. For example: a concentration unit change will be updated in the Review of Literature SOP, the Technical Support Document and the AQUIRE help file. The technical writer performs these updates and summarizes the updates in the monthly report file on the computer of the technical writer.

Backup floppy diskettes of documents archived BEFORE a major revision are stored in the desk of the Technical Writer. These files are in the diskette box labeled "historical files." These files are retained until the next occurrence of a major revision.

Programmer SOPs

The programmer documentation is currently being transferred from VAX maintained files to hypertext mark up language (HTML). Both documented systems are presented until the transfer is complete.

VAX System

By typing "TODO AQMOD_DOC" will present the contents of this document for editing purposes. Typing "TODSR AQMOD_ DOC" will present the document to the user's screen. Typing "TODSR AQMOD_DOC LASER" will produce an output copy to the system laser printer. See Table 3 for a list of documentation with the corresponding VAX filenames.

FILES ON VAX DIR "TODO$DIR:"

DOCUMENTATION FOR:	VAX FILENAME	REVISION DATE
AQUIRE Modification Software	AQMOD_DOC.TODO	04/25/96
Ecotoxicological Database Programmer Procedures	EDPP_DOC.TODO	04/25/96
AQUIRE Search/Retrieval Software	AQUIRE_DOC.TODO	04/26/96
AQUIRE Database Software	AQUIREDB_DOC.TODO	04/25/96
AQUIRE Tape Making	TAPE_MAKING_DOC.TODO	08/19/96
QSAR Database Modification Software	QSMOD_DOC.TODO	04/23/96
ECOTOX	ECOTOX_USE.TODO	04/23/96
ECOTOX	ECOTOX_DOC.TODO	04/30/96
AQ_MOD_SI?		?

Table 3 VAX "TODO" Files

HTML System

All draft HTML pages are located in /usr/local/eco/docs on Ontario. To print these files you will need all of the files in this directory as well as the subdirectory "graphics." To begin, you should open up the file "index.htm" with your browser (i.e. Netscape). From there, you will need to follow the links to the various documents and print them. Large documents that are complete are: AQUIRE, ECOTOX, AQMOD, AQUIREDB and ASTER. In addition, the ECOTOX page contains links to some detailed design documents that should be printed. Each of the major documents

contains a link to the Libraries page. This should be printed as well as the main page for each of the individual libraries. Do not go as far as printing the source. You may wish to print the glossary as well.

AQUIRE Staff Skill Mix

The composition of the core database staff includes a database/project coordinator, literature reviewer, technical support staff, and a programmer/analyst. Expansion of the staff to include multiple document reviewers, technical staff, and programmer/analysts results in a greater volume and diversity of publications reviewed, growth in the size and scope of the database, and increased effectiveness and flexibility of database software for data storage and retrieval. Table 4 provides an itemization of database tasks and the staff distribution required to complete the tasks.

Database/Project Coordinator: The database and/or project coordinator is responsible for the development, coordination and implementation of the technical support system. This support includes the identification of software development needs, coordination with user support tasks, supervision of review, technical support, data entry and quality assurance tasks, and preparation of documentation. The position requires specific expertise: a MS/BS/BA in science-based curriculum, three to five years experience in database development and/or toxicity testing, oral and written communication, and leadership skills.

Literature Reviewer: The reviewer is responsible for the acquisition, cataloging and review of aquatic toxicity literature, species and chemical verification, supervision of data entry tasks, maintenance of support files, and implementation of quality assurance procedures. The position requires specific scientific expertise: BS/BA in science-based curriculum, one to three years experience in toxicity testing and literature review; and organization, teamwork, and accuracy skills.

Technical Support: The technical support staff provide support for the bibliographic, species and chemical data files. This position requires a high school diploma with two years of science or library-based education or experience, organization, teamwork and accuracy skills.

Technical Writer: The technical writer is responsible for the coordination of documentation development, updating, and distribution. This position requires a high school diploma with at least two years of document preparation experience, organization, teamwork and accuracy skills.

Data Entry: The data entry staff provide support for the primary data files, support files, quality assurance, and document archiving. This position requires a high school diploma with one year of computer, word processing or data entry skills.

Programmer Coordinator: The programmer coordinator is the primary interface between the programmer/analysts and the database and project coordinator. The programmer coordinator is advised of new data and anticipated changes in the data reviewing procedures that would affect software development. This position requires a MS/BS/BA in computer science based curriculum with three to five years of management experience.

Programmer/Analyst: The programmer/analyst is responsible for the development, maintenance and upgrade of the system software. This position requires computer programming expertise: BS/BA in computer/mathematical or information management programming based curriculum, including two to five years experience in designing, implementing, and testing software with specific emphasis in database management systems. Experience with FORTRAN and C++ programming languages or VMS or UNIX operating systems is preferred.

Table 4 Task List and Staff Assignment

Task	Staff
LITERATURE ACQUISITION	
Perform and identify literature from database searches	Reviewer
Perform and identify manual searches	Reviewer
Check RETOX, ordered, received and reject boxes	Technical
Order and photocopy publications	Data Entry
Format and skim received publications	Technical
Perform QA on RETOX entries	Data Entry, Reviewer
Prepare and maintain citation cards/file publications	Data Entry
REVIEW OF LITERATURE	
Distribute publications for review	Coordinator
Review publications	Coordinator, Reviewer
Train new reviewers and perform cursory checks on completed reviews	Coordinator
Track and perform quality assurance of 10% replicate reviews	Contractor Database Coordinator
Data maintenance	Reviewer/ Technical
Duplicate data resolution	Reviewer
Tracking data records in RETOX	Reviewer
DATA ENTRY (AQMOD)	
Data entry (AQMOD)	Data Entry
QA of data entry	Data Entry, Reviewer
Coding sheet filing/maintenance	Data Entry
SPECIES PROCEDURES	
Verification of Latin name and taxonomic hierarchy	Reviewer/ Technical
Data entry (SPECTAR)	Data Entry
QA of species names	Data Entry, Technical

Task	Staff
Maintenance of synonyms	Technical
Maintenance of RESPEC, taxonomic references	Reviewer, Data Entry
CHEMICAL PROCEDURES	
Verification of CAS numbers, preferred names, SMILES	Technical
Data Entry (CHEMNAME, QSMOD)	Data Entry
QA of CAS numbers in CAS registry handbook	Reviewer
Chemical card maintenance/filing	Technical
USER SUPPORT	
Coordinate and track user support requests	Tech Writer
Maintain and update Standard Operating Procedures	Tech Writer
Update user manual, technical support document, online welcome and help screens	Tech Writer
Compile information for quarterly user updates	Tech Writer
Assist in compiling and tracking information for non-English data exchanges (i.e. OECD and Borok Institute)	Tech Writer
SOFTWARE	
Perform data updates	Programmer
Develop and maintain data entry software	Programmer
Develop special purpose software as per Reviewer needs	Programmer
Maintain and update programming documentation	Programmer
Maintain and update procedure files to run software	Programmer